

**Flint Creek Embayment  
Wheeler Reservoir  
Intensive Basin Survey 2015**

**WHEL-6:** Flint Ck approx 1 mi downstream of AL67 bridge at public access area (Morgan Co 34.558/-

**BACKGROUND**

The Alabama Department of Environmental Management (ADEM) began monitoring lake water quality statewide in 1985, followed by a second statewide survey in 1989. In 1990, the Reservoir Water Quality Monitoring Program [now known as the Rivers and Reservoirs Monitoring Program (RRMP)] was initiated by ADEM.

The current objectives of this program are to provide data that can be used to assess current water quality conditions, identify trends in water quality conditions and to develop Total Maximum Daily Loads (TMDLs) and water quality criteria. Descriptions of all RRMP monitoring activities are available in ADEM’s 2012 Monitoring Strategy (ADEM 2012).

In 2015, ADEM monitored the Flint Creek tributary embayment of Wheeler Reservoir as part of the basin assessment of the Tennessee River under the RRMP. This site was selected using historical data and previous assessments. The purpose of this report is to summarize data collected in the Flint Creek embayment (WHEL-6) during the 2015 growing season (Apr-Oct). This is the fourth basin assessment of the Tennessee River since ADEM began sampling. Monthly and/or mean concentrations of nutrients [total nitrogen (TN); total phosphorus (TP)], algal biomass/productivity [chlorophyll *a* (chl *a*); algal growth potential testing (AGPT)], sediment [total suspended solids (TSS)], and trophic state [Carlson’s trophic state index (TSI)] from 2015 were compared to ADEM’s historical data and established criteria.

A consumption advisory was issued by the Alabama Department of Public Health in 2010 for mercury in fish from Flint Creek. As a result, the section of Flint Creek from AL Hwy. 67 to the railroad bridge is listed on the 2014 Alabama’s Clean Water Act (CWA) §303(d) list of impaired waters for not meeting its water use classifications.

**WATERSHED CHARACTERISTICS**

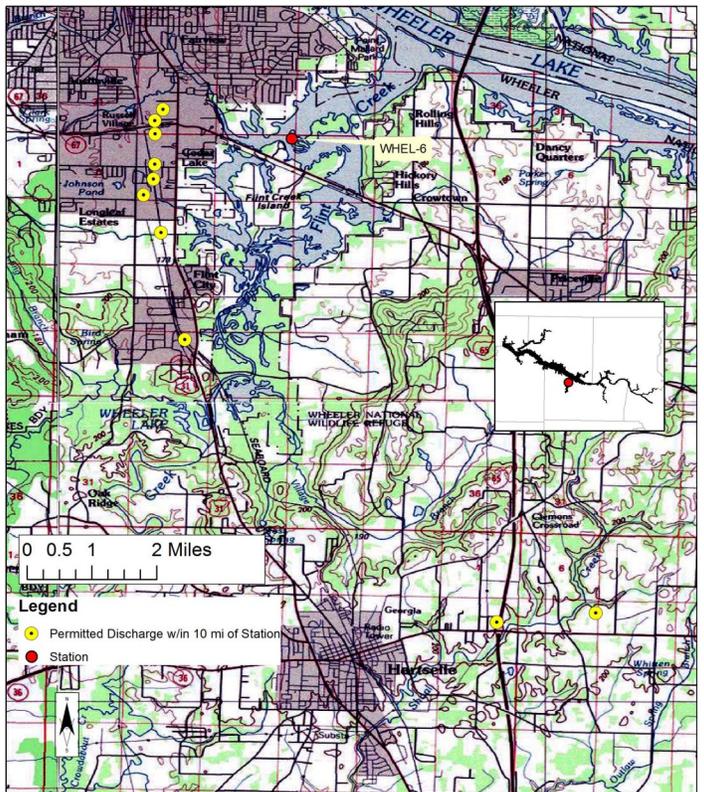
Watershed land uses are summarized in Table 1. Flint Creek is classified as a *Fish & Wildlife (F&W)* stream located in the Eastern Highland Rim ecoregion (71g). Based on the 2006 National Land Cover Dataset, land use within the 457 mi<sup>2</sup> watershed is a mix of hay/pasture and forest (35%) (Fig. 3). As of January 28, 2016, ADEM has issued a total of 142 NPDES permits within the watershed. Ten of those permits are located within 10 mi of the station (Fig. 2).

**SITE DESCRIPTION**

The Flint Creek embayment at WHEL-6 is located approximately 1 mile upstream from Point Mallard Water Park, flowing into the Tennessee River at mile 308. The station is at the confluence of Flint Creek and Branch Creek. The Flint Creek embayment is generally shallow with a mean bottom depth of 4.42 m (Table 2) at the sampling location.



**Figure 1.** Photo of Flint Creek at WHEL-6.



**Figure 2.** Map of Flint Creek embayment of Wheeler Reservoir. Though additional permitted facilities may occur in the watershed (Table 1), only those within 10 miles upstream of the station are displayed on the map.

## METHODS

Water quality assessments were conducted at monthly intervals, April-October. All samples were collected, preserved, stored, and transported according to procedures in the ADEM Field Operations Division Standard Operating Procedures (ADEM 2015), Surface Water Quality Assurance Project Plan (ADEM 2012), and Quality Management Plan (ADEM 2013).

Mean growing season TN, TP, chl *a*, and TSS were calculated to evaluate water quality conditions. Monthly concentrations of these parameters were graphed with ADEM's previously collected data to help interpret the 2015 results. Carlson's TSI was calculated from the corrected chl *a* concentrations.

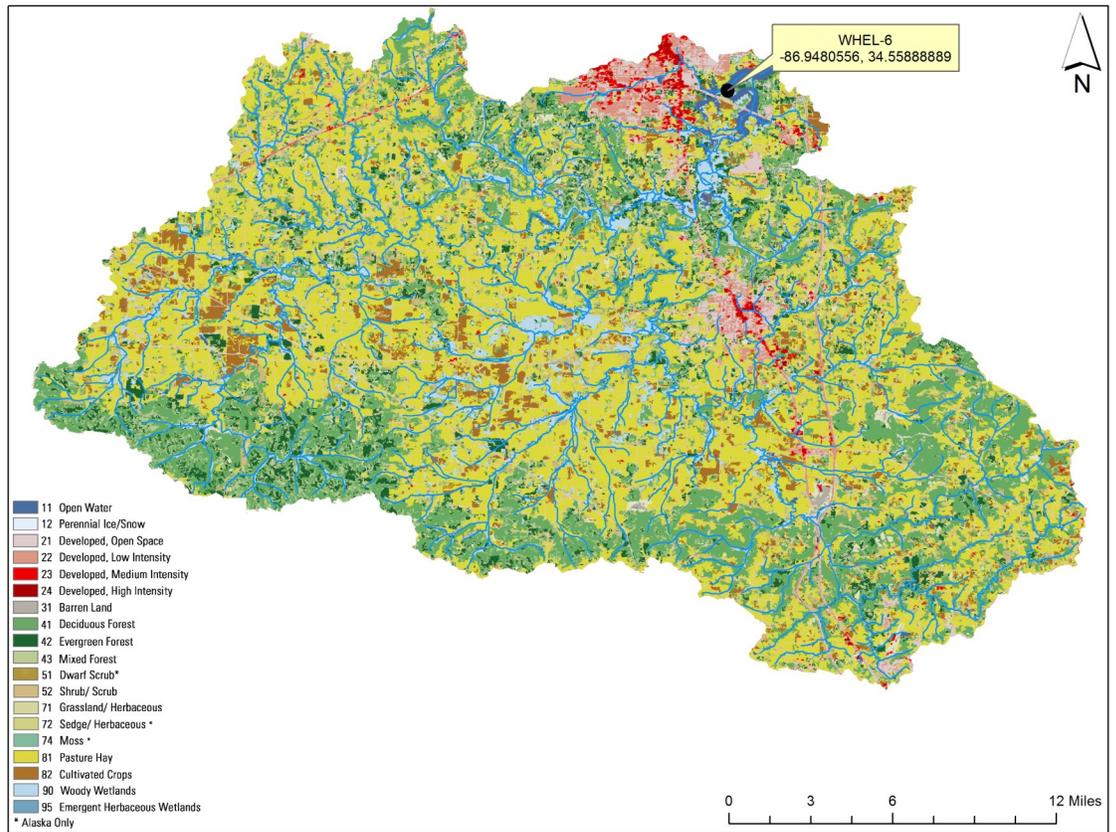


Figure 3. Landuse within the Flint Creek watershed at WHEL-6.

Table 1: Summary of Watershed WHEL-6

Basin	Tennessee R
Drainage Area (mi <sup>2</sup> )	457
Ecoregion <sup>a</sup>	71g
% Land use	
Open Water	1%
Developed	6%
Open Space	
Low Intensity	2%
Medium Intensity	1%
High Intensity	<1%
Barren Land	<1%
Forest	23%
Deciduous Forest	
Evergreen Forest	6%
Mixed Forest	6%
Shrub/Scrub	7%
Herbaceous	2%
Hay/Pasture	37%
Cultivated Crops	5%
Wetlands	5%
Woody	
Emergent Herb.	<1%
# NPDES outfalls <sup>b</sup>	TOTAL
Construction Stormwater	50
Small Mining	6
Industrial General	61
Industrial Individual	6
Municipal	7
Underground Injection Control	12

a. Eastern Highland Rim

b. #NPDES outfalls downloaded from ADEM's NPDES Management System database, Jan 28, 2016.

## RESULTS

The following discussion of results is limited to those parameters which directly affect trophic status or parameters which have established criteria. Results of all water chemistry analyses are presented in Table 2. The axis of the graphs in Figs. 4-6 were set to maximum values reservoir wide so all embayment reports on the same reservoir could be compared.

Mean growing season TN values increased 2003 through 2013 then declined in 2015 (Fig. 4). Monthly TN concentrations were highest in July.

The mean growing season TP concentration increased slightly in 2015 compared to 2013 but remained lower than 2003 and 2009 (Fig. 4). The highest monthly TP concentrations were measured in April and August.

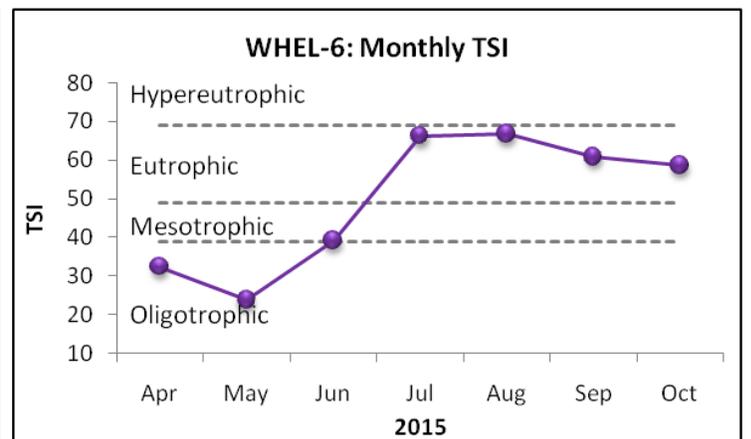
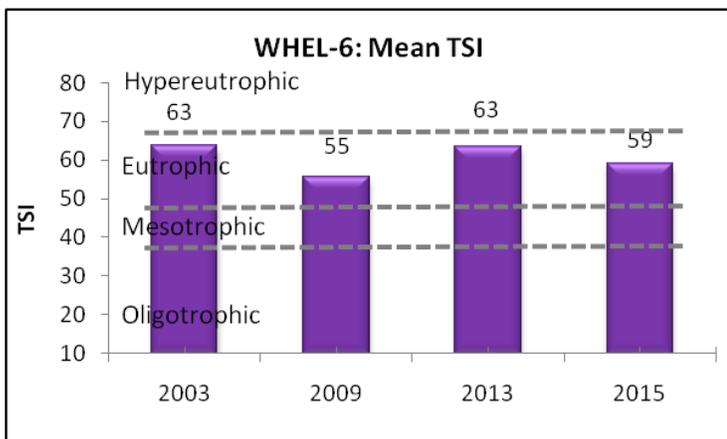
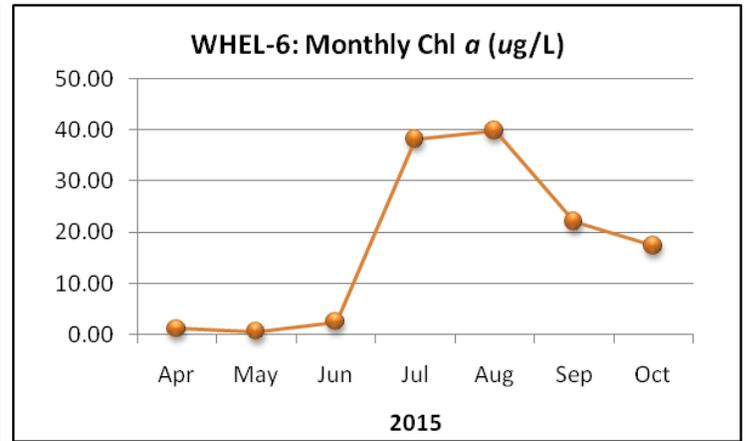
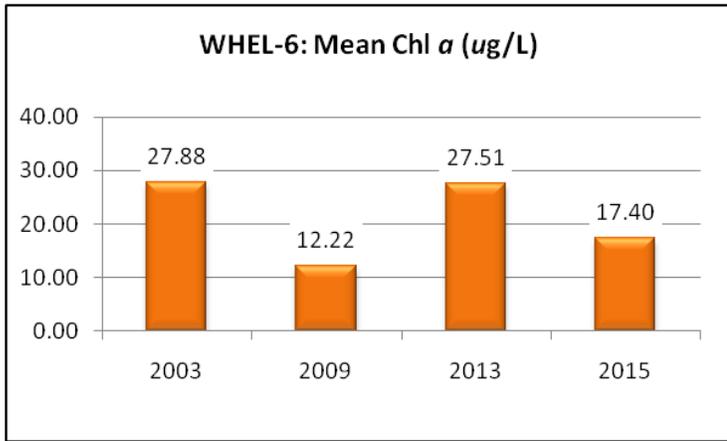
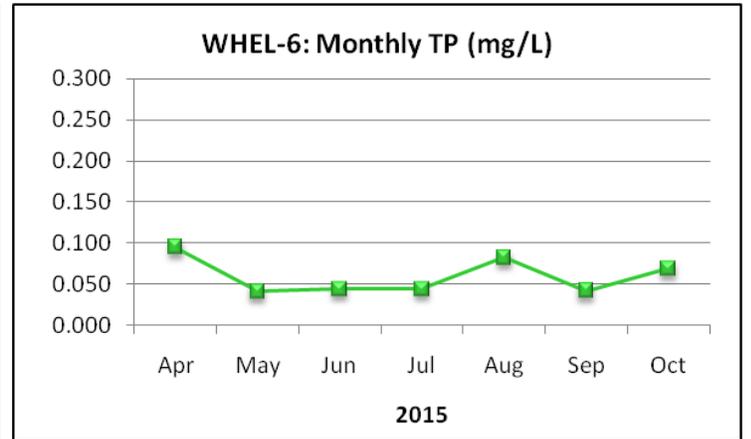
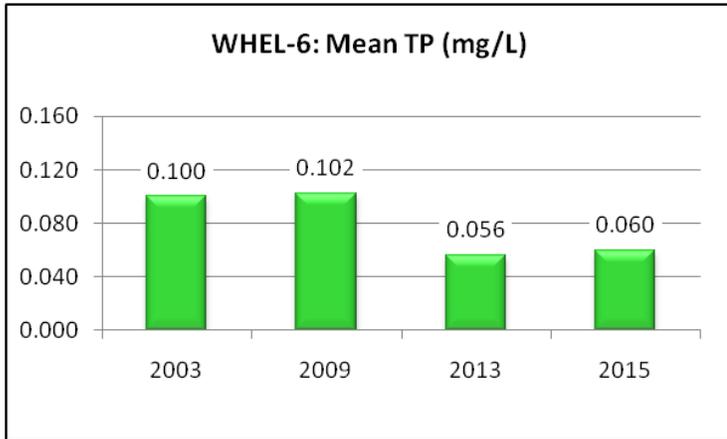
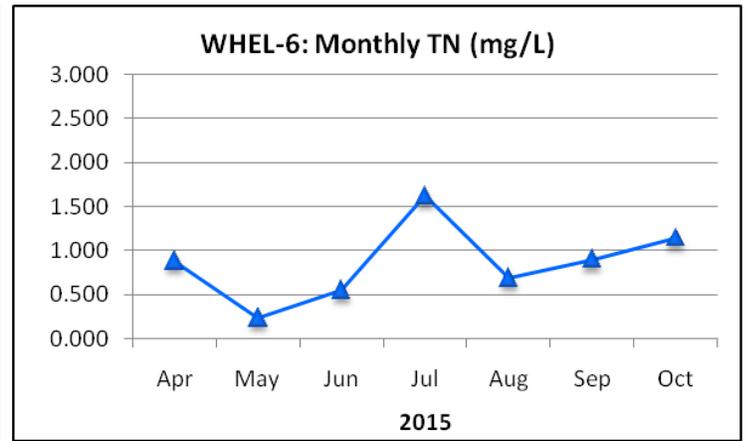
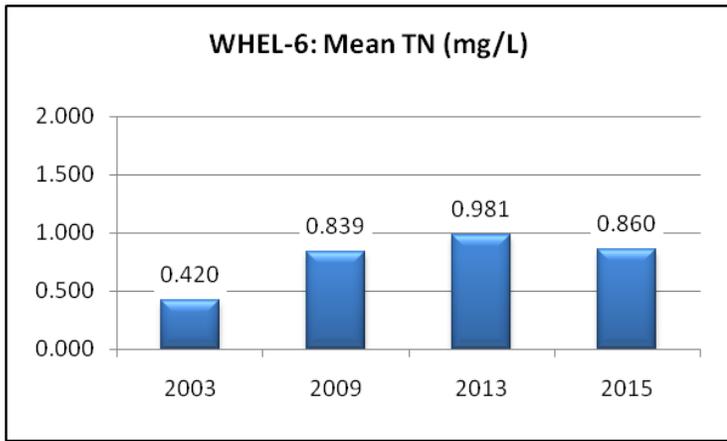
Growing season mean chl *a* values have varied 2003 through 2015 with the highest concentrations measured in 2003 and 2013 (Fig. 4). Monthly chl *a* concentrations were highest in July and August.

Mean TSI has remained eutrophic all years monitored reaching near hypereutrophic conditions in 2003 and 2013 (Fig. 4). Monthly TSI in Flint Creek was oligotrophic April and May then increased to eutrophic conditions July through October, reaching near hypereutrophic conditions July and August.

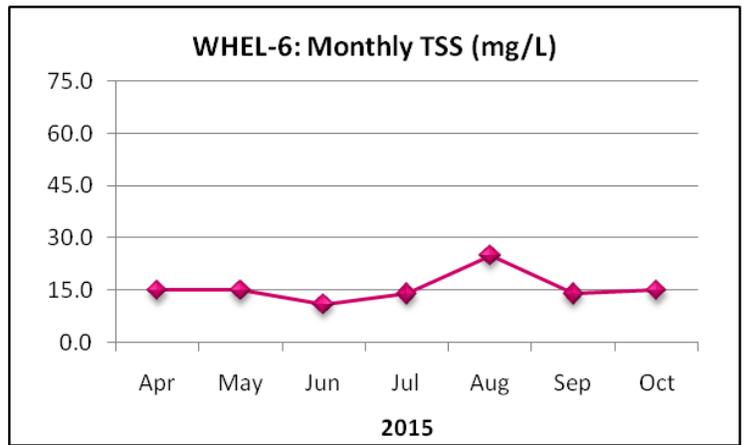
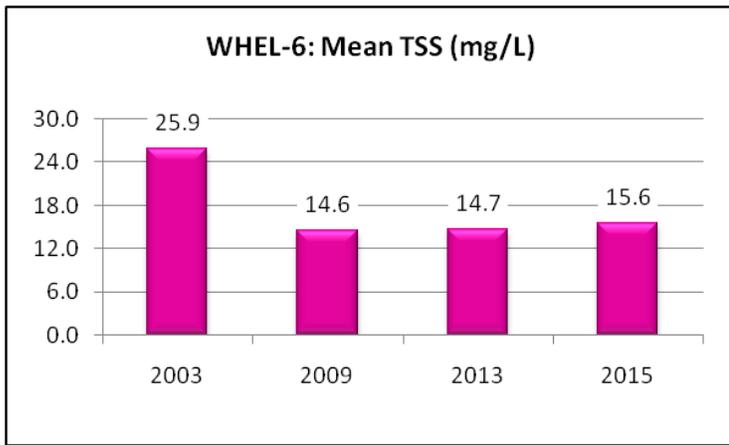
The mean growing season TSS value has increased slightly 2009 through 2015 but remained lower than 2003 (Fig. 5). Monthly TSS concentrations were highest in August.

No AGPT sample was collected from Flint Creek in 2015. Results from 2003-2013 are shown in Table 3.

DO concentrations in the WHEL-6 station were below the ADEM criteria limit (ADEM Admin. Code R. 335-6-10-.09) of 5.0 mg/L at 5.0 ft (1.5 m) in July (Fig. 6).



**Figure 4.** Mean growing season (2003-2015) and monthly (April-October, 2015) TN, TP, chl *a* and TSI measured in the Flint Creek embayment of Wheeler Reservoir. Vertical axis ranges are set to maximum values reservoir-wide for comparability between embayment reports within the same reservoir.



**Figure 5.** Mean growing season and monthly TSS measured in the Flint Creek embayment of Wheeler Reservoir.

**Table 2.** Summary of water quality data collected April-October, 2015. Minimum (Min) and maximum (Max) values calculated using minimum detection limits. Median (Med), Mean, and standard deviations (SD) values were calculated by multiplying the MDL by 0.5 when results were less than this value.

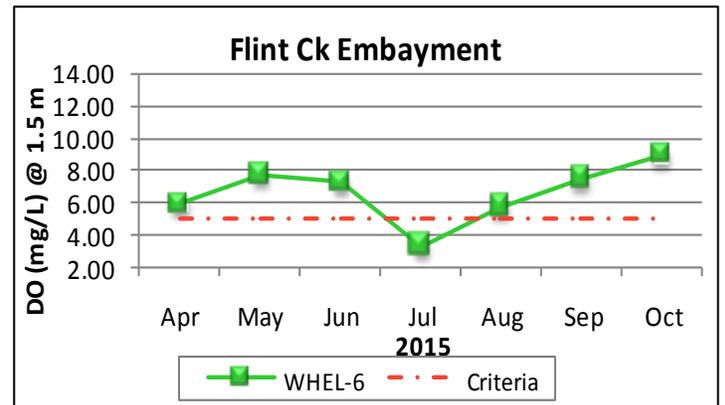
WHEL-6	N	Min	Max	Med	Mean	SD
<b>Physical</b>						
Turbidity (NTU)	7	13.3	24.9	17.5	17.3	3.9
Total Dissolved Solids (mg/L)	7	91.0	128.0	107.0	109.7	12.6
Total Suspended Solids (mg/L) <sup>J</sup>	7	11.0	25.0	15.0	15.6	4.4
Hardness (mg/L)	4	73.0	109.0	88.6	89.8	16.2
Alkalinity (mg/L)	7	68.9	104.9	88.6	87.1	12.8
Photic Zone (m)	7	1.35	2.04	1.68	1.68	0.22
Secchi (m)	7	0.51	0.87	0.68	0.70	0.13
Bottom Depth (m)	7	4.00	5.01	4.46	4.42	0.35
<b>Chemical</b>						
Ammonia Nitrogen (mg/L) <sup>J</sup>	7	< 0.010	0.096	0.019	0.028	0.032
Nitrate+Nitrite Nitrogen (mg/L) <sup>J</sup>	7	< 0.001	0.293	0.001	0.043	0.110
Total Kjeldahl Nitrogen (mg/L)	7	0.231	1.620	0.690	0.817	0.454
Total Nitrogen (mg/L) <sup>J</sup>	7	< 0.233	1.621	0.883	0.860	0.443
Dissolved Reactive Phosphorus (mg/L) <sup>J</sup>	7	0.006	0.045	0.008	0.013	0.014
Total Phosphorus (mg/L)	7	0.041	0.095	0.044	0.060	0.022
CBOD-5 (mg/L) <sup>J</sup>	7	< 2.0	2.5	1.0	1.2	0.6
Chlorides (mg/L)	7	2.2	5.3	3.6	3.7	1.0
<b>Biological</b>						
Chlorophyll a (ug/L)	7	< 1.00	40.00	17.40	17.40	17.04
E. coli (col/100mL) <sup>J</sup>	3	3	9	3	5	3

<sup>J</sup>= one or more of the values is an estimate; N=# samples.

**Table 3.** Algal growth potential test results (expressed as mean MSC) dry weights of *Selenastrum capricornutum* in mg/L) and limiting nutrient status. MSC values below 5 mg/L are considered to be protective in reservoirs and lakes (Raschke and Schultz 1987).

WHEL-6	MSC	Limiting Nutrient
8/19/2003	3.09	NITROGEN
8/19/2009	3.84	NITROGEN
8/21/2013	3.65	NITROGEN

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**Figure 6.** Monthly DO concentrations at 1.5 m (5 ft) for Flint Creek embayment station of Wheeler Reservoir collected April-October 2015. ADEM Water Quality Criteria pertaining to reservoir waters require a DO concentration of 5.0 mg/L at this depth.

## REFERENCES

- ADEM. 2015. Standard Operating Procedures Series #2000, Alabama Department of Environmental Management (ADEM), Montgomery, AL.
- ADEM. 2013. Quality Management Plan (QMP) for the Alabama Department of Environmental Management, Alabama Department of Environmental Management (ADEM), Montgomery, AL. 58 pp.
- ADEM. 2012. Quality Assurance Project Plan (QAPP) for Surface Water Quality Monitoring in Alabama. Alabama Department of Environmental Management (ADEM), Montgomery, AL. 78 pp.
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